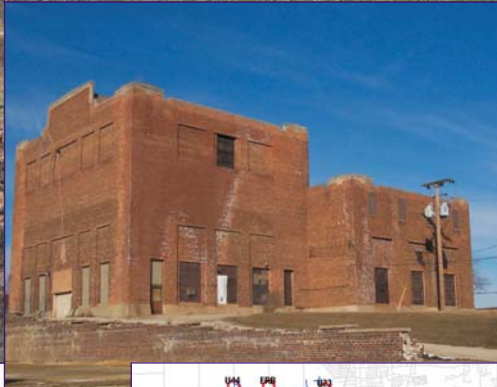
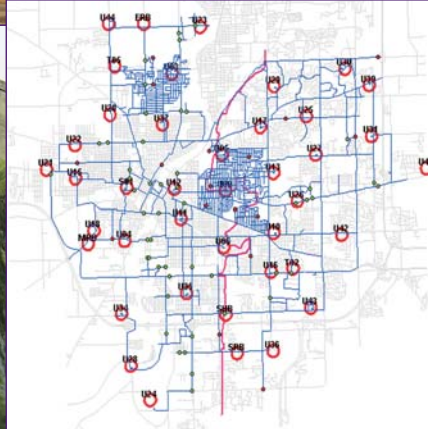
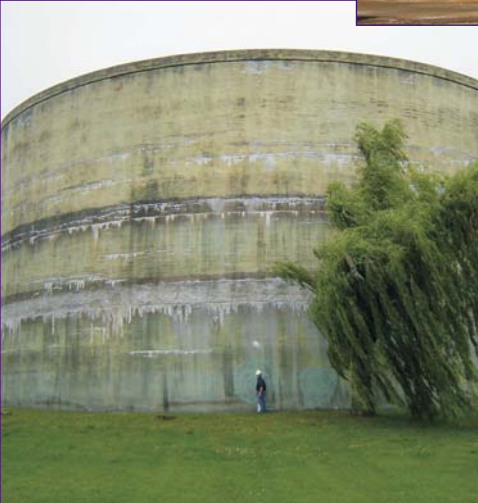




CITY OF ROCKFORD
Rockford, Illinois



WATER SYSTEM REHABILITATION PLAN



McMAHON
ASSOCIATES, INC.
ENGINEERS ■ ARCHITECTS
PROJ. MGRS. ■ SURVEYORS



August 2005

WATER SYSTEM REHABILITATION PLAN

Prepared by



in cooperation with

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July 2005

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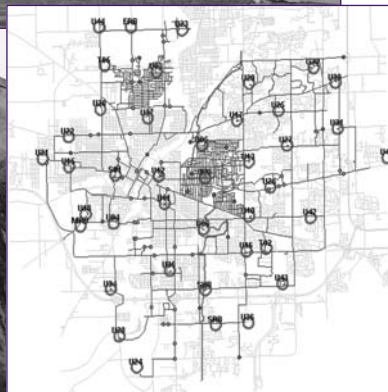
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EXECUTIVE OVERVIEW



EXECUTIVE OVERVIEW

Current State of the Rockford Water System

The City of Rockford is at a critical point in the management of its water supply infrastructure. Current indicators related to water quality, water delivery and the overall physical condition of facilities suggest that the Rockford water system is in need of an immediate and comprehensive program of capital improvements just to be able to provide its customers with the level of service associated with a modern water utility. Consider the following:

- Many customers of the Rockford water system continue to be dissatisfied with the quality of their water. During the first five months of 2005, Rockford received more than 166 complaints related to the quality of its water from customers throughout the City.
- In January 2005, the City received confirmation from the Illinois EPA that radionuclide levels in five of its existing water supply wells had exceeded federally set standards. As a result, the City must now submit a plan for achieving compliance with the standards to the IEPA by February 1, 2006 and implement improvements required to achieve compliance by October 1, 2009.
- Customers in portions of the Rockford water system service area routinely complain of low and/or inconsistent service pressures. Field measurements confirm that service pressures drop below the City's current target pressure of 40 psi in some areas under certain conditions, sometimes reaching levels as low as 30 psi. In other portions of the system, service pressures have been documented to vary widely (20 – 30 psi) over periods of a few minutes to a few hours. These variations in pressure directly impact the level of service provided to customers.
- Parts of the City where rapid growth and development are occurring include the relatively high elevation areas east of I-90 between East State Street and Riverside Boulevard, and west of Owen Center Road/north of West State Street. With the current pressure zone configuration, the Rockford water system cannot provide acceptable levels of pressure to all of these growth areas.

- Water system operators rely on a computerized system for monitoring and control of the network of wells, pumps, tanks and water main. Yet, only about one-quarter of the pressure data reported back to operators is representative of conditions in the system as experienced by utility customers.
- The physical infrastructure that makes up the Rockford water system is aging, with many components approaching the end of their useful lives. More than 25% of the City's water supply facilities, 50% of its major water storage facilities and 42% of its water main are now more than 50 years old. The effects of this aging on system capacity and reliability are readily apparent at sites such as the U15 Reservoir (only 20% of capacity usable due to structural concerns), Unit Wells U13, U15, U23 and U24 (current reliable pumping capacity is less than half the original facility design capacity), and locations affected by major water main breaks (Church Street, South Main and Green Street). In addition, an initial analysis suggests that the City's existing wells and pumping stations are using more than 1.5 times as much energy as would be expected for modern, efficient units.

City staff continue to work diligently to manage the existing water system and maintain basic levels of service despite these challenges. However, without action, the current combination of water quality, water delivery, and physical condition challenges facing the City will increasingly impact the performance and reliability of the Rockford water system, particularly during periods of high water demand such as those experienced during June and July of this year.

Action Plan

Given the conditions described above, the City Public Works Department recognized that an aggressive, short-term program of rehabilitation was needed. In May, the City hosted an intensive, three-day workshop session involving City staff as well as representatives of three consulting firms (McMahon Associates, MWH, Strand Associates) with specific expertise in the planning, design and implementation of water system improvements. During the workshop, participants focused specifically on the analysis of available data and the development of the basis for and specific elements of a short-term rehabilitation plan for the Rockford water system. Key outputs from this effort included the following conclusions:

1. Water system management has an obligation to present to the community a plan for re-establishing a modern, reliable and efficient water utility capable of reliably delivering high quality water to its customers at acceptable levels of pressure and flow.
2. Service levels in the Rockford water system need to be upgraded now. Further delays may impact the system's ability to meet regulatory and industry minimum standards for performance. A three-year target was adopted for implementation of the rehabilitation plan.
3. No fundamental change in the City's source of water supply or primary distribution system would be practical in short term. Using the existing wells and distribution piping must be the basis for the rehabilitation plan.
4. Readily apparent, short-term improvements in water quality, delivery and system condition are essential to the public support and acceptance of this program.

Proposed Rehabilitation Plan for the Rockford Water System

The plan proposed for the rapid rehabilitation of the Rockford water system is based on a fundamental shift in the operating philosophy for the system. Historically, system operators have focused on minimizing the delivery of poor quality water to Rockford customers. The proposed approach is centered around an emphasis on the delivery of high quality water to the greatest degree practical. The key to this shift in operating philosophy is the identification and development of a "Base System" of facilities that provides for treatment of Rockford's groundwater and is capable of reliably delivering treated water to City customers under as wide a range of operating conditions as possible. Base System facilities would be operated according to a "first on, never off" strategy. Operators would use this set of facilities to deliver high quality water at consistent service pressures over the broad range of normal demands experienced most of the time in the Rockford system. Supplemental or "Secondary" facilities, delivering lower quality water, would then only be used as necessary to meet peak demands that occur for a limited time during a typical year. During these high demand periods, the impact of the secondary facilities on overall water quality should be limited due to their relatively small contribution to the overall supply.

Figure EO-1 illustrates this strategy using theoretical data for the Rockford system. As the figure shows, a base system capable of reliably delivering water at a rate up to about 150% of

the average daily system demand should be able to meet system needs for almost 90% of the hours in a given year.

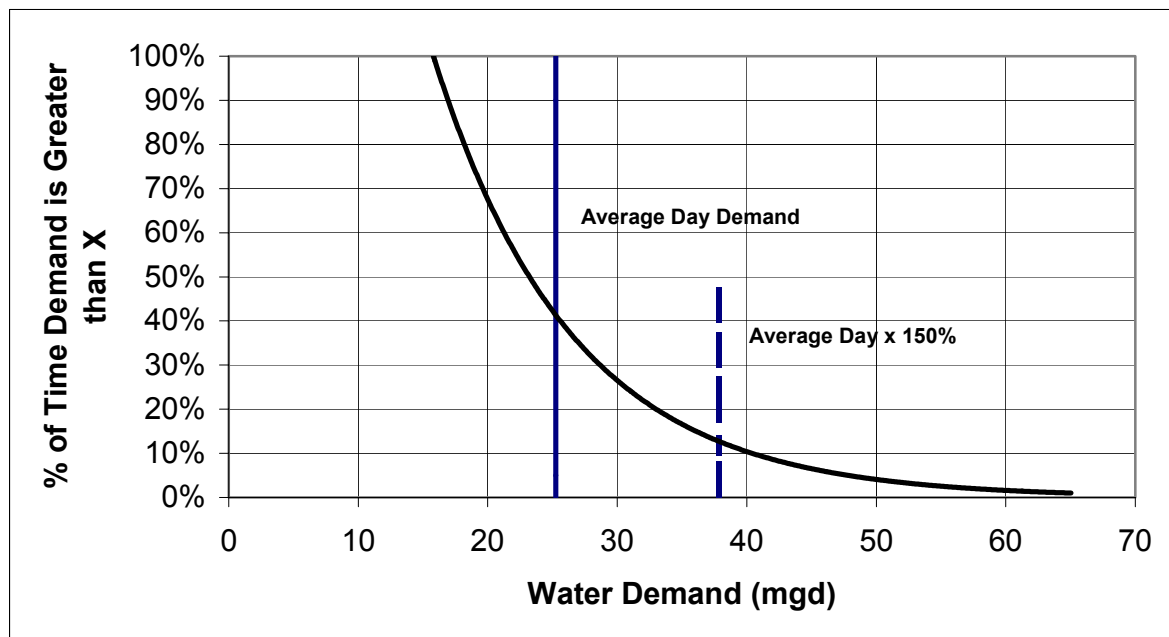


Figure EO-1 - Theoretical Distribution of Rockford Hourly Water Demands

Evaluation of the characteristics of all of the various water supply facilities and their relative importance to overall operation of the Rockford system resulted in the identification of a Base System made up of 18 well/pumping station facilities and 5 major ground storage tanks located within the system's three pressure zones as listed in Table EO-1.

Table EO-1

**PROPOSED BASE SYSTEM FACILITIES
ROCKFORD, ILLINOIS WATER SYSTEM**

West High Zone	Central Zone	East High Zone
U18*	S01*	U05
U21	U03	U13*
U44	U06	U29
	U22	U30*
	U24	U31*
	U34	U36
	U37	U40
		U42
		U43

Note: * indicates well/pumping station facility with major ground storage reservoir

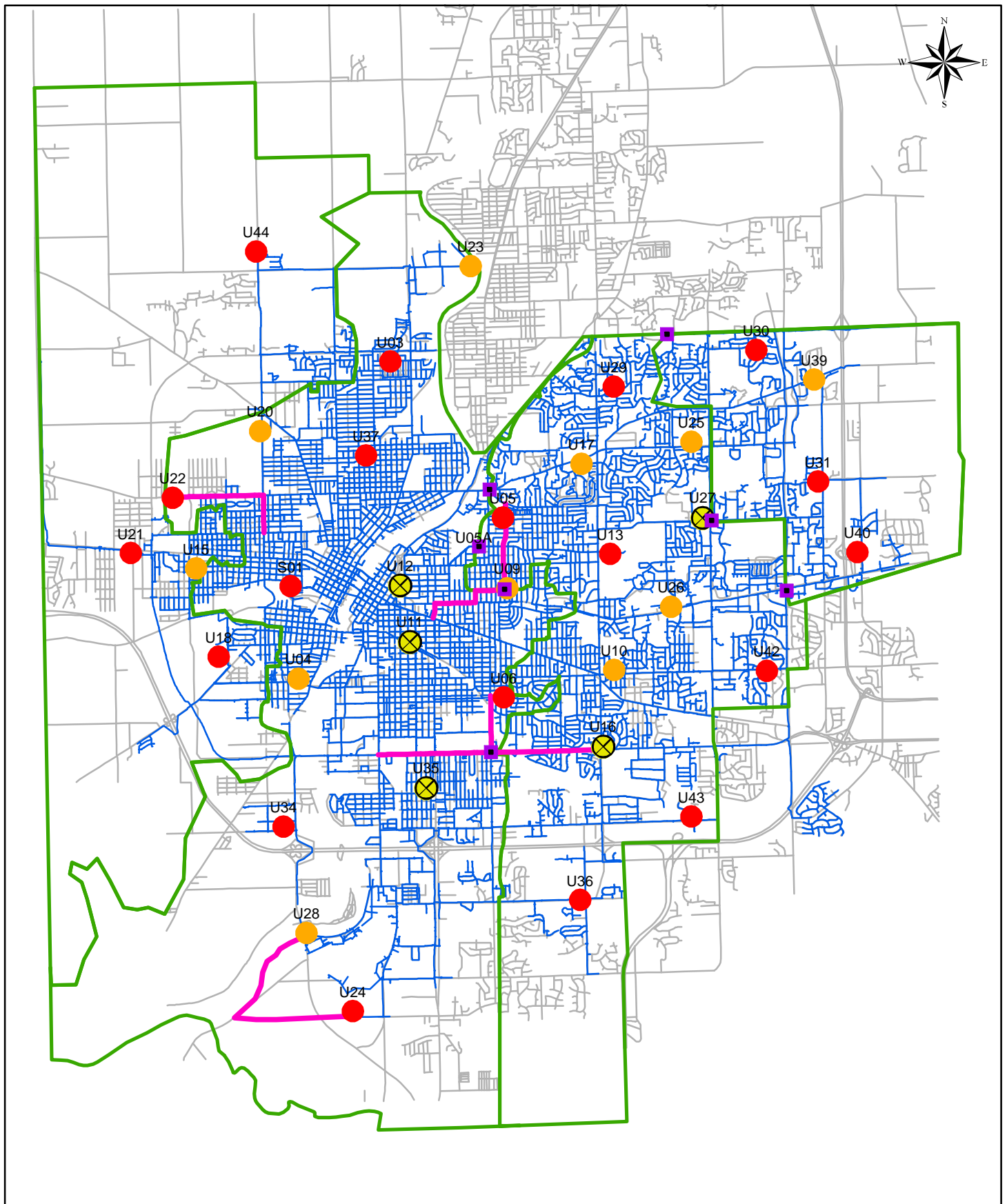
Figure EO-2 shows the overall configuration of the proposed Rockford Base System. Major water transmission and zone control valve improvements required to support operation of the Base System are also shown. Table EO-2 illustrates the way in which the proposed Base System facilities could be used (with appropriate transfers of water between pressure zones) to supply up to 97% of the estimated maximum day demand and 98% of the estimated peak hourly demand for the Rockford water system.

Table EO-2

**2005 MAXIMUM DAY AND PEAK HOUR WATER DEMANDS
AND PROJECTED BASE SYSTEM SUPPLY CAPACITY
ROCKFORD, ILLINOIS WATER SYSTEM REHABILITATION PLAN**

Supply/Demand Scenario	West High Zone	Central Zone	East High Zone	Total System
Base System Supply	6.8 mgd	17.9 mgd	25.9 mgd	50.6 mgd
2005 Max Day Demand	3.6 mgd	28.4 mgd	20.2 mgd	52.2 mgd
% of 2005 Max Day Demand	189%	63%	128%	97%
2005 Peak Hour Demand	5.4 mgd	42.6 mgd	30.3 mgd	78.3 mgd
Available Major Storage	6.2 MG	5.2 MG	14.7 MG	26.1 MG
Flow Available from Storage During Peak Demand Periods	6.2 mgd	5.2 mgd	14.7 mgd	26.1 mgd
Base Supply plus Flow from Storage	13.0 mgd	23.1 mgd	40.6 mgd	75.2 mgd
% of 2005 Peak Hour Demand	241%	54%	134%	98%

*Notes: Maximum Day Demands for all zones are assumed to be equal to 2.0 x the average day demand
Peak Hour Demands for all zones are assumed to be equal to 3.0 x the average day demand
Central Zone base supply includes a new 2000 gpm well at the Stanley Street site.
Flow available from storage = 50% of available storage delivered over a 12 hour period.*



Legend

- Base System
- Secondary
- ⊗ To Abandon
- Proposed Valves
- Main Improvements
- Pressure Zones
- Existing Water Main
- Streets

0 1 2 Miles

Figure EO-2
Rockford Water System with
Proposed Rehabilitation
Improvements

Water System Rehabilitation Plan
 City of Rockford, Illinois



Rehabilitation Plan Implementation

A broad range of capital improvements will be required to fully implement the proposed rehabilitation plan for the Rockford water system within the proposed three-year time frame. Major categories of projects required include:

- Preliminary Engineering and Pilot Studies – Preliminary engineering and pilot studies are required to finalize details related to the basis for design of specific water treatment, facility rehabilitation, water main, and control system improvements. Pilot testing of iron, manganese and radium removal systems is particularly critical to the design of effective and reliable treatment systems.
- Water Supply Improvements – Proposed water supply improvements include well rehabilitation, well pump replacement and water treatment improvements to be constructed at individual well/pumping station sites. Proposed iron, manganese and radium removal system account for over 90% of the total costs associated with the proposed rehabilitation program.
- Water Pumping and Storage Improvements – Water pumping and storage improvements proposed as part of the rehabilitation plan for the Rockford water system range from the construction of brand new pumping stations to replacement of electrical gear, installation of new variable frequency drives, and site/building repairs. The largest portion of the costs in this category are associated with the planned construction of new pumping stations at the Stanley Street and U05 sites.
- Water Transmission/Distribution Projects – The water transmission and distribution system improvements recommended as part of the rehabilitation plan for the Rockford water system include piping and control valve improvements needed to complete the creation of the new west high and east high-high pressure zones, as well as selected main improvements needed to facilitate the movement of water within and between zones. A total of almost 60,000 feet of new water main ranging in diameter from 12-inches up to 24-inches is proposed under the current rehabilitation plan.
- Control and Monitoring Projects – Upgrades to the City's existing SCADA system and installation of additional pressure monitoring points are recommended to provide

accurate data for effective control and management of the Rockford water distribution system.

- Community Expansion Needs – In addition to the improvements recommended as part of the systemwide rehabilitation plan, City staff have identified as necessary further water main improvements proposed to provide expanded service in two critical growth areas along the eastern and western edges of the current service area. A new water supply well and a total of 35,400 feet of new water main ranging in diameter from 16-inches up to 20-inches is recommended to provide service throughout these areas.

Costs for implementation of the three year program are estimated to total approximately \$71.86 million, with expenditures of between \$14.67 million and \$29.62 million per year. Table EO-3 provides a summary of the estimated program costs by major project category and program year.

Table EO-3

OPINION OF PROBABLE PROJECT COSTS
ROCKFORD WATER SYSTEM REHABILITATION PLAN

Improvement Category	Opinion of Probable Costs (millions)				
	Category Total	Year 0	Year 1	Year 2	Year 3
Preliminary Engineering and Pilot Studies	\$1.00	\$1.00	\$0.00	\$0.00	\$0.00
Water Supply Improvements	\$36.69	\$0.00	\$5.59	\$18.46	\$12.64
Water Pumping and Storage Improvements	\$11.19	\$0.00	\$4.26	\$4.76	\$2.17
Water Transmission/ Distribution Improvements	\$15.19	\$0.00	\$4.39	\$2.33	\$8.48
Control and Monitoring Improvements	\$1.30	\$0.00	\$0.43	\$0.44	\$0.44
Community Expansion Improvements	\$9.49	\$0.00	\$0.00	\$3.59	\$5.90
TOTAL ESTIMATED PROGRAM COSTS	\$74.86	\$1.00	\$14.67	\$29.57	\$29.62

Rehabilitation Plan Results

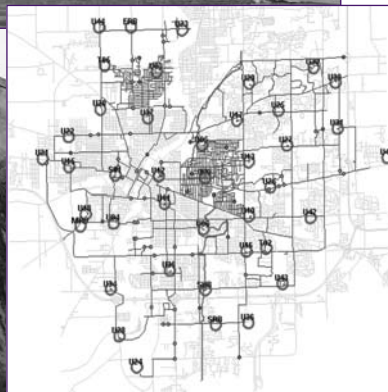
Implementation of the proposed program of water system rehabilitation projects will result in highly visible improvements in the quality, delivery and image of the Rockford water system. Specific benefits that will result from the program include:

- significantly reduced levels of iron and manganese that have historically contributed to customer complaints related to “rusty” water;
- reductions in the concentrations of radionuclides in the City’s water to levels below the USEPA mandated maximum contaminant levels;
- improved service pressures for customers located in relatively high elevation areas and reduced variations in service pressures provided to other customers;
- extension of reliable water supply capacity to City-identified immediate expansion areas;
- improved availability of accurate, representative data on system conditions and performance to water system operators; and
- improvements in the performance, reliability, efficiency and physical appearance of key water system supply, pumping and storage facilities.

The overall result of the rehabilitation program will be the re-establishment of the Rockford water system as a modern water utility capable of providing its customers with a consistent, high quality level of service.



1.0 PROBLEM STATEMENT



1.0 PROBLEM STATEMENT

1.1 Introduction

The City of Rockford has reached a critical point in the management of its water supply infrastructure. In recent years, Water Division and Public Works staff have provided water system customers a basic level of service despite limited investment in major upgrades or rehabilitation. However, now, more than 100 years after its initial creation and 35 years since a major program of investment in its infrastructure, the Rockford Water Utility faces serious challenges that require prompt, effective action. These challenges can be generally grouped into three major categories.

- Water Quality – Recent tests have detected radium at levels above the USEPA’s maximum contaminant level (MCL) in 10 of the City’s 39 existing water supply wells, of which three are out of compliance with average radium levels currently exceeding the MCL over four reporting quarters. Two additional wells are expected to be out of compliance once complete data is obtained, for a total of five wells out of compliance with EPA standards. As a result, the City must develop and submit to the Illinois EPA a radium compliance plan by February 1, 2006. The City already has treatment systems at 3 of its wells to remove volatile organic contaminants (VOCs) previously detected at several locations. In addition, the City receives frequent complaints from customers about rusty, orange, yellow or brown water caused by elevated levels of iron and/or manganese. *Action is required to maintain compliance with federal regulations and provide customers with water that consistently meets their expectations for a high quality product.*
- Service Pressures – Field measurements indicate that service pressures provided to individual customers in the Rockford water system vary over a wide range depending on system demand and operating conditions. At some locations, changes in pressure of 30 psi or more have been observed to occur within periods of 15 minutes or less. The impacts of such variations are particularly noticeable in areas where normal service pressures are marginally acceptable. Fluctuations in pressure of this magnitude can affect the level of service perceived by customers as well as the actual performance of industrial processes, irrigation sprinkler, and/or fire protection systems. *Action is required to provide all customers throughout the City’s service area with acceptable and consistent service pressures.*

- System Condition and Capacity – Many of the facilities that make up the Rockford water system were installed more than 50 years ago and are in need of major repair, rehabilitation or replacement. The deteriorating condition of the system is evident in main breaks, concrete spalling from aging storage reservoirs, and pumping facilities that are out of service due to equipment failures. Visible deterioration of facilities also contributes to a public perception that the City's water system is a poor quality system. City staff goes to great lengths to maintain a basic level of service to customers. However, when the usable capacity of a reservoir or well is limited due to age or condition, the operators' ability to manage the system and respond to changing demands is constrained. *Action is required to identify critical facilities, preserve their capacity and maintain the overall reliability of the Rockford water system.*

Further discussion of each of these challenges follows.

1.2 Water Quality

The Rockford Department of Public Works has identified improvement in the overall quality of the water that it delivers to customers as its highest priority for the near term. This emphasis on improved water quality is driven by a combination of regulatory changes, changes in raw water quality, and increasing public expectations. Specific water quality issues that need to be addressed by the City are related to levels of radium, volatile organic contaminants, and iron and manganese. The hardness of the City's water supply has also been identified as a potential issue for water system customers.

1.2.1 Radium

Radium is a naturally occurring radioactive element that is present in varying amounts in rocks and soil within the earth's crust. Small quantities of radium derived from these sources can also be found in groundwater supplies. Concentrations of the naturally occurring radioactive isotopes radium-226 and radium-228 in excess of the U.S. Environmental Protection Agency (EPA) standard for drinking water have been detected in water from deep aquifers used for public supplies throughout sections of northern Illinois, southern Wisconsin and other parts of the midwestern United States. Long-term exposure to radium and other radionuclides in drinking water has been reported by the USEPA to result in increased risks of cancer.

EPA standards regulating the levels of radionuclides in drinking water have been in effect since 1977. However, new rules made effective in December of 2003 included new requirements for monitoring intended to ensure that all customers of community water systems will receive water that meets the Maximum Contaminant Levels (MCL) for radionuclides in their water. A municipality is considered to be out of compliance with the regulations if the average level of contaminants measured over four quarters exceeds the MCL. Additionally, the December 2003 rules require that water systems monitor for radionuclides at all entry points to the water system, not just at “representative locations”. For Rockford, this change meant that initial sampling was required at all of its wells.

Based on screening samples taken in 2003, the City identified a need for detailed testing of radium levels in the water from 20 of its 39 wells. Testing conducted through early 2005 showed that radium levels exceeded the federal MCL of 5 pCi/l for over an average of four quarters at three of the City’s wells. Radium levels were found to consistently exceed the MCL at two more wells. In total, radium levels above the MCL have been detected during at least one quarter at ten of the City’s wells. A summary of results from the City’s recent radium testing is presented in Table 1.1. Figure 1.1 shows the locations of these wells within the City.

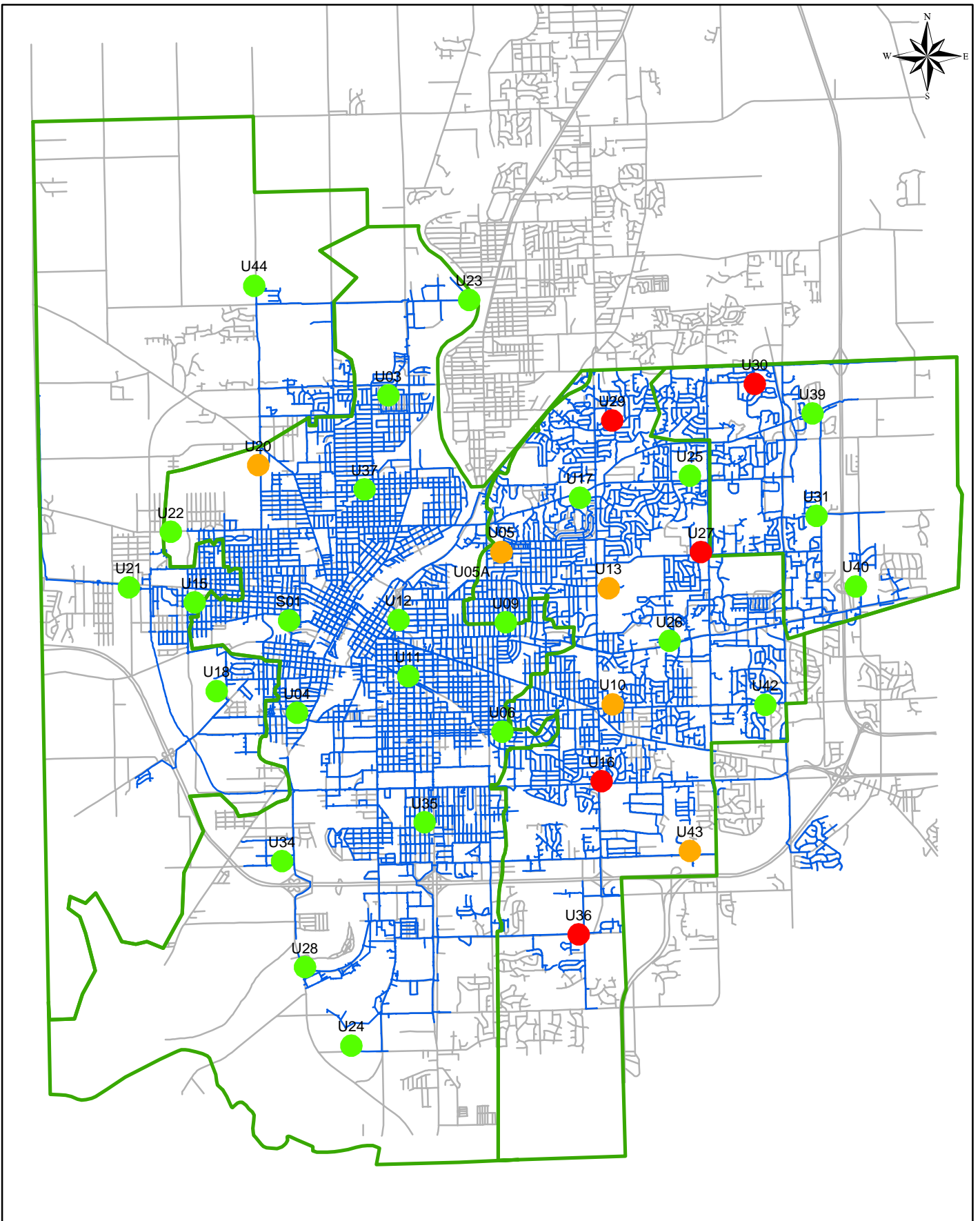
The City has notified the Illinois EPA of these results and has received formal notification of non-compliance. As a result, the City is required to prepare and submit to IEPA a plan for addressing these radium issues and bringing the water supply into compliance with current water quality standards. The plan must be submitted to the IEPA by February 1, 2006. Elements of the plan must then be implemented by October 1, 2009 and must demonstrate compliance with the Radionuclide Rule by April 1, 2011.

Table 1.1

COMBINED RADIUM 226/226 RESULTS: 2004-2005
CITY OF ROCKFORD WATER SYSTEM

Well Site	2004				2005		<u>Quarters > MCL</u> Samples
	Q1	Q2	Q3	Q4	Q1	Q2	
S01	1.2	2.3	2.5	3.6	2.1	4.1	0/6
U03		2.0	3.5	2.6	3.4	3.5	0/5
U05/U05A		5.1	4.0	3.3	4.4	4.6	1/5
U10		4.1	5.1	4.6	4.7		1/4
U13	3.4	3.2	5.8	3.2	2.2		1/5
U15		2.7	(1)	2.6	2.8	4.2	0/4
U16	5.1	5.2	6.2	5.5	6.5		5/5
U17		2.2	2.8	3.6	2.7	3.3	0/5
U18		3.1	4.6	3.1	4.9	4.1	0/5
U20		5.4	4.8	4.9	5.6	4.3	2/5
U21		1.7	5.0	2.2	4.5	3.5	0/5
U22	2.3	2.8	4.1	3	1.8		0/5
U27	5.1	6.7	7.5	8.4	7.9	6.6	6/6
U29	6.2	7.0	(1)	(1)	(1)		2/2 (2)
U30		5.7	8.1	4.4	5.1	4.8	3/5
U36	6.4	5.8	7.1	7.8	6.4	5.4	6/6
U39	3.5	3.5	4.3	4.7	4.3	4.3	0/6
U43	4.2	4.2	7.4	4.9	5.1		2/5

Note: (1) oos = Out of service at time of sampling
 (2) Gross Alpha levels have exceeded MCL of 15 pCi/l



Legend

- 4 Quarters Average > MCL
- 1 Quarter > MCL
- 0 Quarters > MCL
- Pressure Zones
- Existing Water Main
- Streets

0 1 2 Miles

Figure 1.1
Radium Level in Wells

Water System Rehabilitation Plan
City of Rockford, Illinois

1.2.2 Volatile Organic Contaminants (VOCs)

Groundwater pumped from several of the City's existing wells has been found to contain levels of various volatile organic contaminants. At present, the City samples and analyzes groundwater pumped from wells at nine locations for VOCs on a quarterly basis. Granular Activated Carbon (GAC) filters are in place at unit wells U24, U28 and U35 to remove VOCs from the groundwater before it is pumped into the distribution system. Current VOC levels in the groundwater are such that the GAC filters are only in use at U35. No treatment is currently required at the City's other well sites to meet drinking water standards.

Table 1.2 provides a summary of the current status of VOC sampling and treatment at Rockford's well sites. The locations of wells that are sampled on a quarterly basis and those with GAC filters in place are shown on Figure 1.2.

1.2.3 Iron and Manganese

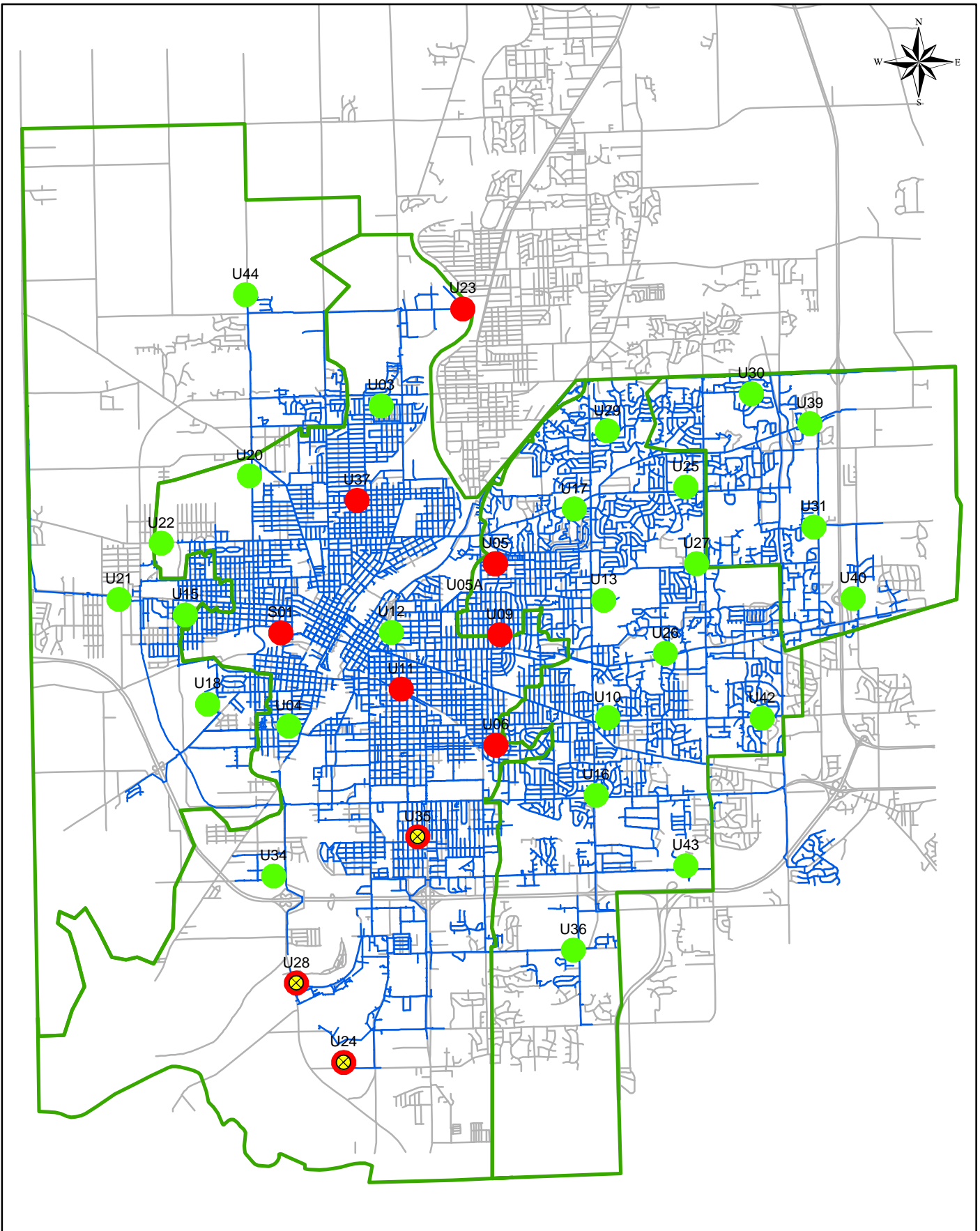
Iron and manganese are two inorganic constituents that typically pose no health risk to water system customers, but which frequently contribute to complaints regarding "colored water". These constituents are among those covered by National Secondary Drinking Water Regulations maintained by the USEPA. The USEPA's secondary standards are non-enforceable guidelines regulating contaminants in drinking water that may cause aesthetic (taste, odor, color) or cosmetic effects (skin or tooth discoloration). USEPA standards for iron and manganese in drinking water are 300 ppb (parts per billion) and 50 parts per billion, respectively.

Experience in water systems has shown, however, that customers' thresholds for detection of iron and manganese may be even below the USEPA secondary standards. Thus, customers in some systems may complain of colored water even when levels of iron and manganese are relatively low.

Table 1.2

**VOLATILE ORGANIC CONTAMINANT ISSUES
CITY OF ROCKFORD WATER SYSTEM**

Well Site	Groundwater VOC Levels	VOC Treatment in Place
S01	high at Group Well 6	None
U03	typically below detection limits	None
U04	high	None
U05/U05A	low	None
U06	low	None
U09A	low	None
U10	typically below detection limits	None
U11	low	None
U12	high	None
U13	typically below detection limits	None
U15	typically below detection limits	None
U16	typically below detection limits	None
U17	typically below detection limits	None
U18	typically below detection limits	None
U20	typically below detection limits	None
U21	typically below detection limits	None
U22	typically below detection limits	None
U23	low	None
U24	low	Granular Activated Carbon – Not in Use
U25	typically below detection limits	None
U26	typically below detection limits	None
U27	typically below detection limits	None
U28	low	Granular Activated Carbon – Not in Use
U29	typically below detection limits	None
U30	typically below detection limits	None
U31	typically below detection limits	None
U34	typically below detection limits	None
U35	high	Granular Activated Carbon
U36	typically below detection limits	None
U37	low	None
U39	typically below detection limits	None
U40	typically below detection limits	None
U42	typically below detection limits	None
U43	typically below detection limits	None
U44	typically below detection limits	None



Legend

- Quarterly Sampling
- None
- ⊗ GAC in Place
- Pressure Zones
- Existing Water Main
- Streets

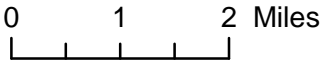


Figure 1.2
VOC's in Wells

Water System Rehabilitation Plan
City of Rockford, Illinois



Figure 1.3 shows the distribution of water quality complaints received by the City of Rockford during the period between January 1, 2005 and June 10, 2005. The plot shows 166 water quality complaint calls made during this period. Of this total, more than 50% referred to rusty brown or orange water. Complaints about yellow or black water accounted for another 33% of the calls. Water with a bad odor accounted for most of the remaining complaints.

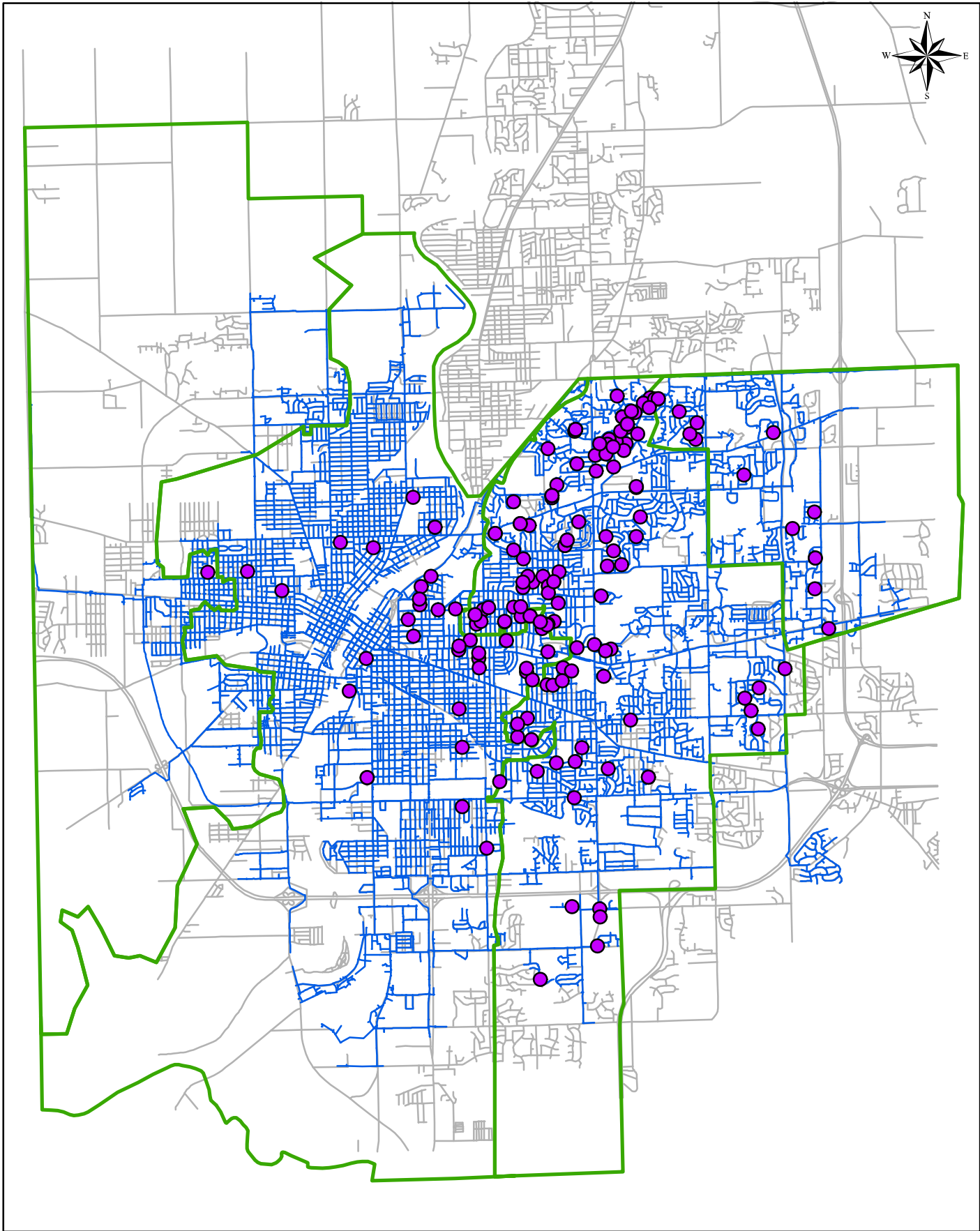
Historic data, summarized in Table 1.3, shows that iron and manganese levels vary significantly among the City of Rockford's water supply wells. Analysis results show that 22 of the City's wells have levels of iron and/or manganese above the current USEPA secondary standards. Fifteen of these wells have iron concentrations above the 300 ppb standard, two have an average manganese level higher than the 50 ppb secondary standard, and five exceed the secondary standards for both iron and manganese. The locations of these wells are shown in Figures 1.4 and 1.5.

1.2.4 Hardness





Hardness is a term used commonly to describe the amount of calcium and magnesium in a certain water. "Hard" water can contribute to scaling and deposition inside pipes or plumbing fixtures as well as the formation of difficult-to-remove soap scum. Hardness does not pose a health risk to water users, but its effects on plumbing fixtures and process equipment are visible. As a result, many water utilities soften their water to reduce the level of hardness in their finished product.

In general, the groundwater pumped from the City of Rockford's wells is hard to very hard. Typical levels of hardness range from 250 parts per million to 400 parts per million. However, levels above 500 parts per million have been detected in some of the City's wells.

Historically, the City of Rockford has not installed softening systems at its well sites to reduce hardness levels. Rather, many residents in Rockford have installed home water softener units to reduce the levels of hardness in their water. Given the widespread use of home water softeners, the lack of customer complaints regarding hardness, and the high cost that would be associated with installation of softening facilities at all of the City's wells, improvements to reduce hardness levels have not been identified as a critical part of the City's water system rehabilitation program.



Legend

-  Water Quality Complaints
-  Pressure Zones
-  Existing Water Main
-  Streets

0 1 2 Miles

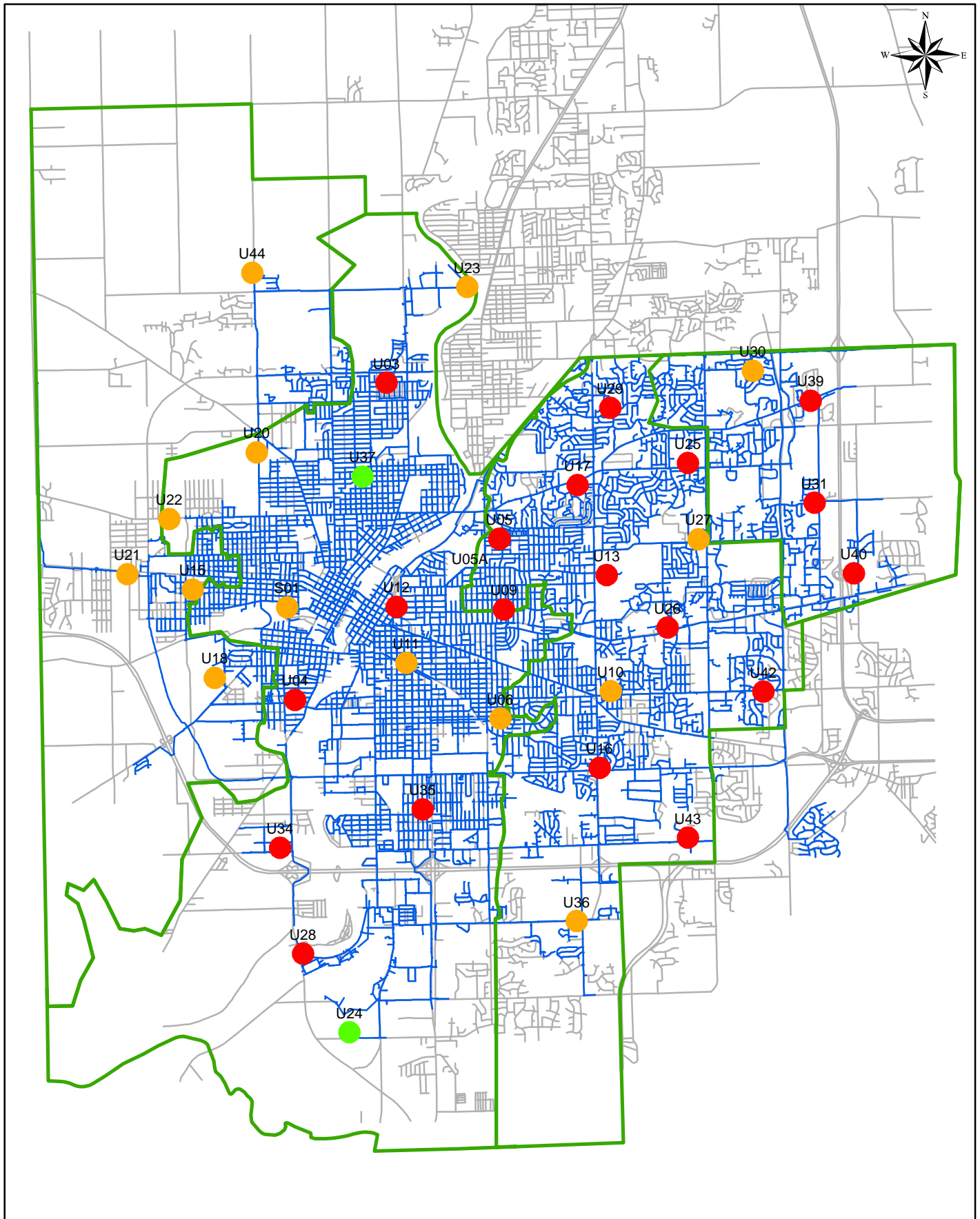
Figure 1.3
January 1, 2005 - June 10, 2005
Water Quality
Water System Rehabilitation Plan
City of Rockford, Illinois



Table 1.3

**AVERAGE IRON AND MANGANESE CONCENTRATIONS
CITY OF ROCKFORD WATER SUPPLY**

Well Site	Average Iron Concentration (ppb)	Average Manganese Concentration (ppb)
S01	199	4.9
U03	305	11.3
U04	324	0
U05/U05A	1026	101.1
U06	209	16
U09A	1143	165.8
U10	248	4
U11	215	176.1
U12	340	78
U13	491	10.7
U15	208	0
U16	420	3.2
U17	1449	20.4
U18	157	3.8
U20	81	0
U21	89	11
U22	480	2.7
U23	110	52.4
U24	0	0
U25	1016	17.3
U26	525	5.1
U27	192	0
U28	517	99.0
U29	426	0
U30	257	14
U31	682	5.3
U34	367	3.3
U35	665	306.1
U36	126	2.6
U37	0	11
U39	695	15.5
U40	1015	20.3
U42	1058	18.4
U43	310	0
U44	54	2.4

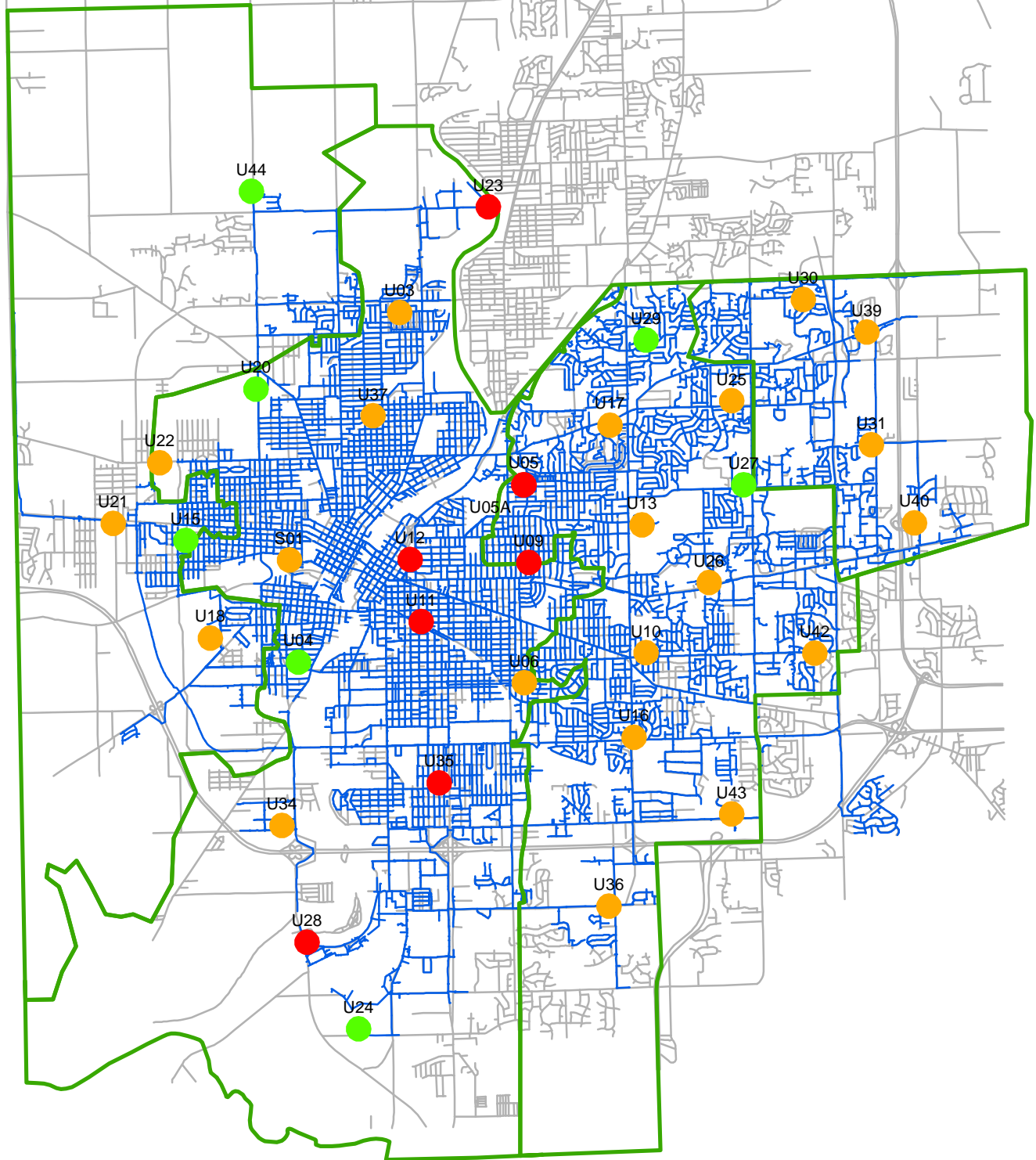


Legend

- > 300 ppb
- < 300 ppb
- None
- Pressure Zones
- Existing Water Main
- Streets

0 1 2 Miles

Figure 1.4
Iron Level in Wells
 Water System Rehabilitation Plan
 City of Rockford, Illinois



Legend

- Average Manganese Concentration**
- > 50 ppb
 - < 50 ppb
 - 0 ppb
- Pressure Zones
- Existing Water Main
- Streets

0 1 2 Miles

Figure 1.5
Manganese Level in Wells

Water System Rehabilitation Plan
City of Rockford, Illinois



1.2.5 Pressure Zone Boundaries

Some water quality issues may be exasperated due to slow-moving water through distribution mains. As water slows down, it allows suspended materials to settle out and concentrate in particular areas of the distribution system. Slower-moving water will also age more as it travels through a distribution system to the final user, which can further deteriorate water quality. Pressure zone boundaries are a common location for these types of water quality issues. The creation of a pressure zone through an established distribution systems creates a number of dead end water mains at the new boundary where maintaining a looped distribution network is not practical. Water within dead end mains may have nowhere to go, which can cause the water to slow down and even become stagnant. These issues often develop slowly over time, and in some systems may never become problematic. However, customer complaints have shown that this is a problem in the City of Rockford, amplifying other water quality issues. Action must be taken to clear the system of existing problems along pressure zone boundaries, and prevent problems from reoccurring in the future.

1.3 Service Pressures

The pressure at which water is supplied directly impacts the level of water service provided to customers and their perception of system adequacy. Generally acceptable service pressures for typical water systems in the midwestern United States range from about 45 psi to 90 psi. In areas with pressures below 35-40 psi, customers may notice reduced levels of flow, especially during periods of high water use.

The City of Rockford currently uses various combinations of its 38 pumping stations to provide water service to an area of more than 56 square miles with a range in ground elevations of nearly 200 feet. Water pressure throughout the area varies with the elevation, with pressure typically decreasing about 9 pounds per square inch (psi) for every 20 foot increase in ground elevation. As a result, customers located at lower elevations can experience service pressures in the 80–90 psi range at the same time that customers on higher ground are receiving water at pressures in the range of 40-45 psi. During peak demand periods, customers in certain parts of the distribution system experience pressures as low as 30-35 psi.

Water system service pressures are also affected by changes in system operation. As the demand for water within the system changes and operators turn individual facilities on or off, service pressures in parts of the system can change. Short duration variations may appear as sudden spikes or drops in pressure. More gradual changes in pressure occur as operating booster pumps move up or down on their curves in response to the changing system demands. Given the limited extent of remote pressure monitoring within the Rockford system, current system operators may not be aware of these changes when they occur away from existing facilities.

Figures 1.6 and 1.7 show service pressures observed over time at two locations in the Rockford system. Items of particular note include the occurrence of low pressure events (less than 35 psi) and the high degree of variability in service pressures (20-30 psi) observed along 21st Street south of Sandy Hollow Road and along Riverside Boulevard east of McFarland Road. These observations confirm the type of pressure problems reported regularly by water system customers. In addition, the results suggest that the level of service provided to customers within the Rockford water system is highly variable. Action is required if consistent and acceptable service pressures are to be provided throughout the service area.

1.4 System Condition and Capacity

A third issue facing the Rockford water system relates to the condition and capacity of the existing wells, pumps, and storage reservoirs. Many of the facilities currently in use are more than 50 years old and are nearing or beyond the end of their useful lives. Other facilities have been taken out of service for extended periods of time as a result of the failure of particular pieces of equipment or systems. Specific examples of the effects of aging on the Rockford water system include:

- Reductions in the reliable production capacity of Unit Wells U15 and U23. Due to the deterioration of these unit wells, facilities at these sites can reliably deliver less than half of their original design capacity.
- Periodic unavailability of facilities site due to deterioration of the electrical systems and pumping systems.

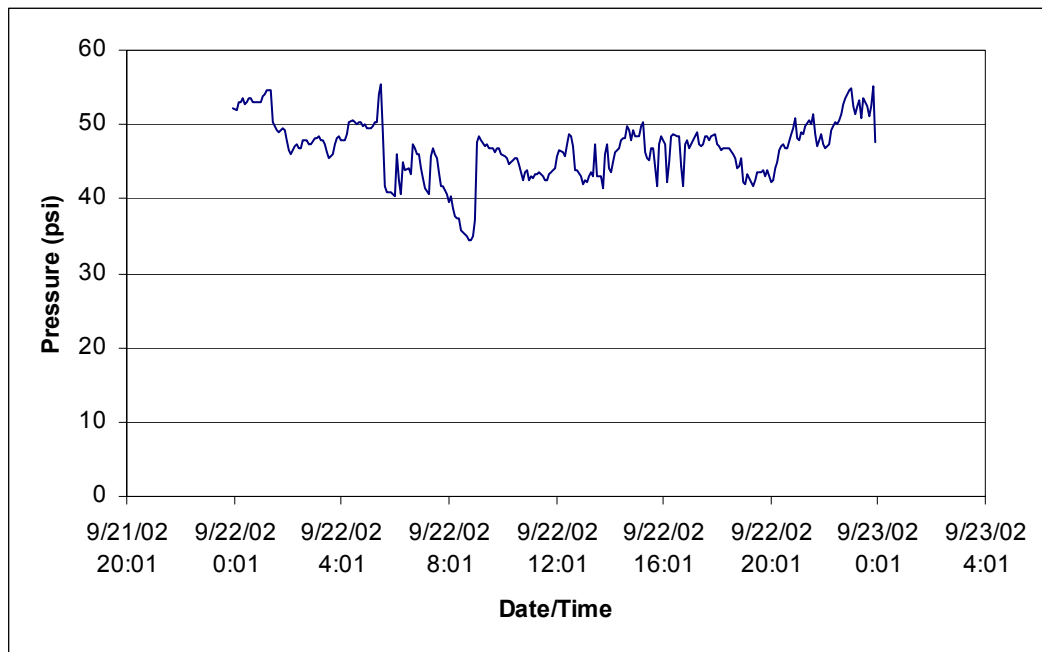


Figure 1.6 – Service Pressures: 21st Street South of Sandy Hollow Road

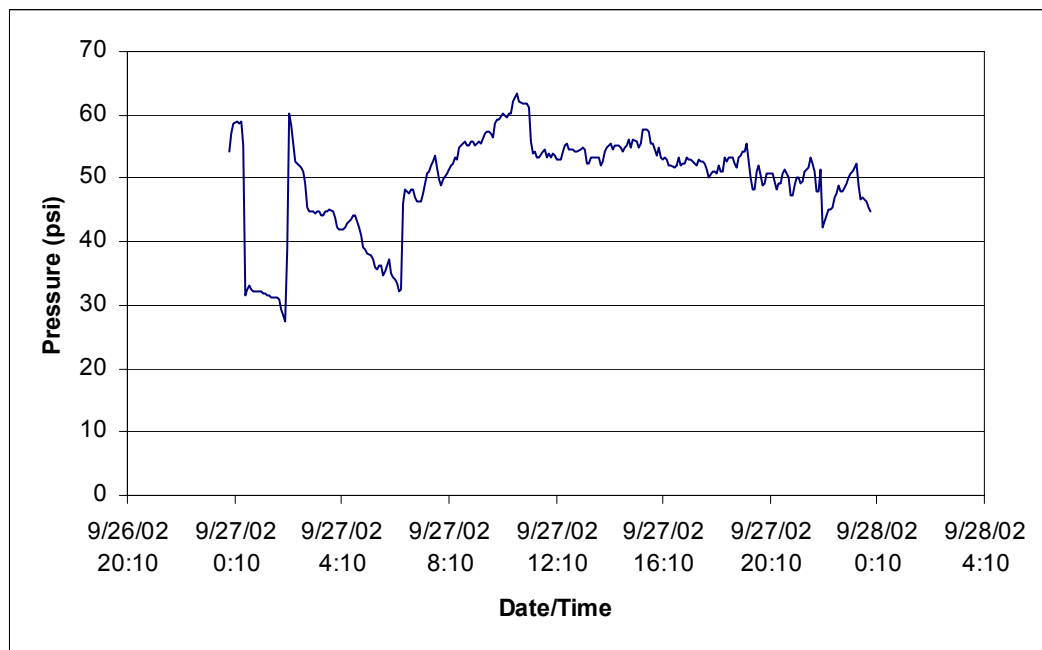


Figure 1.7 – Service Pressures: Riverside Blvd. East of McFarland Road

- Restrictions on the volume of water that can be stored in the 5.2 mgd U15 ground storage reservoir. Presently water system operators make use of only about 20% of the original capacity of the major storage reservoir at U15 due to concerns about the structural integrity of the tank. Similar concerns exist for other aging storage facilities in the Rockford system.

Table 1.4 provides a general summary of the current age of supply/pumping and major storage facilities in the Rockford system. While age alone is not a sufficient factor on which to base replacement efforts, these data clearly show that the key infrastructure that makes up the Rockford water system is relatively old. In addition, experience shows that it is likely these facilities will grow increasingly vulnerable to problems or failure as they continue to age. As a result, action will be required to preserve the capacity and reliability of the Rockford water system as existing facilities and infrastructure approach the end of their useful life.

1.5 Presentation of the System Rehabilitation Strategy

City staff, working with a consultant team, has developed a plan for rehabilitation of the Rockford water system intended to address the issues described above. This plan is focused on rapidly achieving basic targets for service, performance, reliability and efficiency within the existing Rockford water system. The balance of this report describes the features of the existing Rockford water system, the process used to develop the proposed rehabilitation strategy, the elements of the strategy and their probable costs, key actions proposed to support implementation of the strategy, and the estimated impacts of the program on water rates for the customers of the City's water system.

Table 1.4

**APPROXIMATE CAPACITY AND AGE OF KEY ELEMENTS
ROCKFORD WATER SYSTEM**

	For Facilities Built:				
	Pre-1931	1931-1956	1956-1985	1986-1995	1996-2005
Wells/Pumping Stations					
No of Facilities	1	8	20	6	1
Capacity of Facilities (gpm)	3,200	12,750	30,825	12,160	2,250
% of Total Capacity	5%	21%	50%	20%	4%
Major Storage Reservoirs					
No. of Facilities	1	2	4	0	0
Capacity of Facilities (MG)	5.2	10.5	14.2	0.0	0.0
% of Total Capacity	17%	35%	47%	0%	0%
Water Main					
Miles of Main	197	114	300	58	74
% of Total Main by Length	27%	15%	40%	8%	10%